SOLUTIONS TO POWER QUALITY PROBLEMS AT KANDANA WATER SUPPLY SCHEME

A dissertation submitted to the
Department of Electrical Engineering, University of Moratuwa
in partial fulfilment of the requirements for the
Degree of Master of Science

By
UPUL NANDANA ATTANAYAKE

SUPERVISED BY Prof. H.Y.R. Perera
Dr. H.M.Wijekoon.

Department of Electrical Engineering
University of Moratuwa
Sri Lanka

2010

Abstract

Quality of the power supply becomes a key issue in plant automation. Especially, voltage sags appearing on the electricity supply cause voltage sensitive equipment to shut down and incur heavy financial losses to Industrial customers. However, effects of voltage sags can be minimized or mitigated considerably if both utility and the plant are working with good cooperation. This thesis presents power quality issues and mitigating techniques of voltage sag problem at Kandana water treatment plant where sensitive equipment are used for different stage of water treatment and distribution process.

Kandana water treatment plant consists of five pumps having capacity of 500 kW and three pumps with 200 kW capacities. The pumps are controlled by several sensitive electronic devices which are vulnerable to voltage sags. By analyzing the past break down data at Horana Grid substation and plant disturbance recorded at treatment plant and measurement taken with a power quality analyzer it has been observed that the voltage sag appearing at the treatment plant are mainly caused by faults.

First, investigations were carried out to estimate the severity of voltage sag associated with different types of faults in the utility network and their impacts on the equipment installed in the water treatment plant. Then, the effects of voltage sags on the equipment vulnerable for water pumping and distribution process like large pumps with sensitive electronic controllers were investigated to find out a mitigating solution. Detail analysis with theoretical descriptions has been given to describe field observation.

In order to solve the power quality problem especially the voltage sag, several options system level and device level have been considered. It is noted most of the system level mitigating solutions have been implemented by the utility side. Then device level solutions have been introduced. In this sense, Dynamic Voltage Restorer

CDVR) was used to solve the voltage sag problem. Further, designing and controlling of the DVR have been with theoretical derivations and simulations results are given to justify the proposed solution. Remarkably good results have been gained by using this Dynamic Voltage Restorer.